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Higher Education for Deaf Students: Research Priorities in the New Millennium

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A review of research on deaf students in higher education reveals a significant body of knowledge about the barriers these students face in gaining access to information in the classroom. Much less is known about the potential solutions to these problems. In addition, there is a dearth of research on the effectiveness of such support services as interpreting, note taking, real-time captioning, and tutoring, particularly with regard to their impact on academic achievement. This article summarizes relevant research and suggests directions for educational researchers interested in enhancing academic success and the retention of deaf students in higher education programs.

Today, more than 25,000 students with hearing loss are enrolled in higher education programs in the United States (National Center for Education Statistics, 1999). Thousands more are attending universities in other countries. For the most part, published research studies related to these students do not identify specific levels of hearing loss. Though the term "deaf" is often used to mean students who have predominantly profound or severe hearing losses without the use of hearing aids, many "deaf" students use hearing aids in the context of their academic studies in higher education. As a result, some of these students are functionally hard of hearing in the classroom. Unless specific reference is made in this article to "hard-of-hearing" students (those with mild or moderate hearing losses), the general term "deaf" will

be used to include the range of students from profoundly deaf to functionally hard of hearing.

The number of deaf students attending universities and colleges has increased dramatically over the past two decades. In the United States, there are several large higher education programs and many smaller ones with enrollments of deaf students. The National Technical Institute for the Deaf at Rochester Institute of Technology in Rochester, New York, has an enrollment of approximately 1,100 deaf students. Gallaudet University in Washington, DC, has approximately 1,300 undergraduate and about 600 graduate students. Information about the number of deaf students attending and the types of support services offered in several thousand two- and four-year college and university programs is available in the 11th Edition of the *College and Career Programs for Deaf Students* (King, DeCaro, Karchmer, & Cole, 2001).

Higher education programs are also offering deaf students opportunities with and without support services in such countries as Australia (Spradbrow & Power, 2000), China (G. Bao, personal communication, 2001), Germany (Cremer, 1991), Israel (Miller & Mizrahi, 2000), Japan (Obata, Okiyoshi, Ohnuma, Nemoto, & Hasegawa (1999), and the United Kingdom (Harrington, 2000). Bao, for example, reports that there are an estimated 21 million deaf and hard-of-hearing people in China, and there are about 700 who can study in the 14 colleges or universities with special programs.

Brelje (1999) writes that, in general, higher education opportunities for hard-of-hearing students in many

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countries are far greater than those for students with more severe hearing losses. No, or very few, students who are severely or profoundly deaf are enrolled in higher education programs in such countries as Egypt, El Salvador, Lebanon, Nepal, Greece, India, Puerto Rico, Saudi Arabia, and Thailand. The major barriers, according to Brelje, are the "continuing attitude among the citizenry of some countries that deaf individuals are not capable of successfully completing a college or university education" (p. 418) and the lack of quality elementary and secondary education programs. While a demographic analysis of these international programs is beyond the scope of this article, it is clear that not only have doors begun to open for deaf people in many countries but also there is a growing body of literature regarding the inclusion of these students and of their educational needs. In Germany, for example, Cremer (1991) reported on a survey of 125 students in higher education with 99.2% of them stating that assistance through support services was a necessity. A high number of respondents (69.5%) identified note takers as important to their success, followed by tutors (59.0%), and interpreters (34.3%), the latter perhaps reflecting the students' oral training in this country. The German students were decidedly in favor of trained tutors (71.4%) as compared to untrained tutors. In contrast, Obata et al. (1999) summarized that 25.6% of the 144 mainstream university and college students in Japan responding to a survey felt that postsecondary institutions were not attractive because there were no special support services.

The U.S. Department of Education's National Center for Educational Statistics (1993) reported on a survey of a sample of two-year and four-year programs in the United States with deaf and hard-of-hearing students for the period 1989/1990 through 1992/1993. The information in this report did not include support service data from Gallaudet University and the National Technical Institute for the Deaf. Of the sampled institutions that provided support services, 75% provided note takers, 67% provided sign language interpreters, and 65% stated that tutors assisted students with ongoing coursework. Of the overall sample of 2,350 institutions with enrollments of deaf and/or hard-of-hearing students, 18% were unable to provide some re-

quested services. Fourteen percent were unable to provide sign language interpreters requested by students.

Even with the expansion of support and access services provided in higher education programs over the past decade, the failure rate remains, on average, dismal. In the United States, for example, only one of every four deaf and hard-of-hearing students graduates (Stinson & Walter, 1997; Walter, Foster, & Elliot, 1987). This graduation rate of approximately 25% is about the same for both two-year and four-year programs in the United States.

Why is the failure rate so high in colleges and universities? The success of these students may depend in part on how research may be applied to optimize the conditions for learning in a timely manner. Through research, we can better understand the problems and approach solutions by planning and implementing programs that improve retention and academic success. However, while many barriers to success in higher education programs have been identified in research studies over the past two decades, solutions have been few and far between. This article will address the need to reconceptualize the kind of research that would likely decrease this failure rate for deaf students in higher education.

Factors Affecting Success in Higher Education

Thirty years of research have helped to clarify several of the factors affecting the success of deaf students higher education. Most of the research summarized here was conducted in the United States. Direct international comparisons are not available, although the needs for support services are universal and similar approaches to addressing such needs can be found in the literature (e.g., Cremer, 1991; Spradbrow & Power, 2000).

Reasons deaf students do not complete their baccalaureate degree programs are numerous. Academic preparation and the challenges of learning through support services are only two pieces of the complex mosaic. Other factors include leaves of absence, program lengths, difficulty in carrying full course loads, dissatisfaction with social life, and changes in career interests (Lang & Stinson, 1982; Stinson & Walter, 1992). Scherer and Walter (1988) interviewed 320 deaf students who were withdrawing from higher education or transferring

to another postsecondary program and reported that inability to decide on a major area of study is an important factor related to persistence.

In summarizing why colleges and universities must attend to the "whole student," Stinson and Walter (1997) described statistically significant relationships between student satisfaction with classes and their academic achievement and between social satisfaction and persistence/withdrawal. These researchers identified three social issues to be addressed for students to adjust effectively to higher education: (1) developing social skills, (2) establishing an identity, and (3) acquiring independence and interdependence. To improve degree completion rates, they recommended admitting students who match the demands of the college or university environment, early identification of the difficulties faced by students, and early and appropriate interventions.

Social/personal factors play a critical role in the success of deaf students in higher education, as well as in subsequent success in the workforce. As with academic factors, the question is whether limited research resources should be invested in better preparing students during the elementary and secondary years in terms of the social/personal skills needed for success in higher education or should focus on assisting the students admitted to the college or university. If only the latter, then the question becomes how we can best develop qualities that will increase their success in higher education. These qualities include, to name a few, self-awareness and its relationship to career awareness (i.e., choosing an appropriate major), persistence, self-identity, self-efficacy, perseverance, ability to accommodate oneself in an integrative environment, and general maturity. Such qualities are not easy to develop in the short college career of the student.

Various studies with both subbaccalaureate and baccalaureate students have shown that academic and social integration are critical factors affecting student persistence (Dagel & Dowaliby, 1989; Dowaliby, Garrison, & Dagel, 1993; Tinto, 1987). In reviewing the research on why deaf students leave higher education, Stinson and Walter (1992) discussed the mixed results and complex relationships related to grades, ability measures, and persistence. Academic skills, demands on communication, achievement test scores, and other academic fac-

tors do predict grades, but social adjustment is a major reason for leaving higher education programs as well. Tinto (1987) states about student departures:

Rather than mirroring academic difficulties, they reflect the character of the individual's social and intellectual experiences within the institution following entry. Specifically, they mirror the degree to which those experiences serve to integrate individuals into the social and intellectual life of the institution. Generally, the more integrative those experiences are, that is, the more they are seen as satisfying and leading to integration into the life of the college, the more likely are individuals to persist until degree completion. Conversely, the less integrative they are, the more likely are individuals to withdraw voluntarily prior to degree completion. (p. 53)

Future efforts to investigate persistence of deaf students in higher education programs may be more fruitful if they focused on these factors, as well as on "ability" factors. On the issue of integration, for example, Stinson and Walter (1997) report a consistent finding is that deaf adolescents in mainstream settings prefer to relate to other deaf students. Research conducted with baccalaureate-level students, however, has shown that deaf students do not feel as much a part of the "university family" as do their hearing peers (Foster, Long, & Snell, 1999).

Kersting (1997) interviewed deaf university students who had little or no previous experience with Deaf culture or language. She reported that feelings of isolation, loneliness, and resentment were most intense during orientation and the critical first year. Alienation from both deaf and hearing peers was experienced, and significant changes in their social lives did not occur until their second and third years, partly as a result of improved communication with deaf peers and increased participation in extracurricular activities. Such "culture shock" was previously reported by Foster (1989) and Foster and DeCaro (1990).

Miller and Mizrahi (2000) studied how university students in Israel, who had hearing loss, related to hearing and Deaf cultures. They report how their orientations to these cultures, as well as their "bicultural identity," "immersion identity," and "marginal identity,"

related to social adjustment and loneliness. Hard-of-hearing students related more closely to hearing culture than students who were "Deaf." Such an orientation, however, was not associated with social adjustment or loneliness among these students. Marginal identity was a better predictor of the hard-of-hearing students' level of loneliness. That is, these students were more lonely when they affiliated neither with hearing nor Deaf culture. Higher scores in immersion identity for Deaf students in this study were associated with lower levels of loneliness in higher education. The relationships between adjustment, identity, and academic success will bear further investigation.

Research on Support Services/Access Services

The struggle to integrate socially and academically is made even more challenging in the classroom where specialized support and access services are commonly offered to deaf students in higher education. The most common types of support services include tutoring, interpreting, real-time captioning, and academic advising. With access/support services comes, for some students, the stigma of being different and, in many colleges and universities, the need to expend valuable time and energy in arranging the appropriate logistics (scheduling of support, covering costs, etc.). Despite the use of such services by thousands of students in higher education, there is sparse published research to guide those interested in providing such support.

One of the most salient characteristics of learning by deaf students in mainstream classrooms is the students' dependence on a third party to provide access to information. In effect, there is little direct communication between teachers and deaf students. Rather, information is received by the student through interpreting and/or real-time captioning during class sessions, or through tutoring and/or notes (note taking or printouts from real-time captioning) outside of class. More recently, educational research has been conducted on automatic speech recognition, using specialized software to translate spoken messages to print (Stinson et al., 1999).

What do we know about the relationship these support services have to actual learning of course material? The following sections summarize relevant studies conducted in several countries.

Tutoring

The fact that deaf students do not receive as much information from classroom lectures as their hearing peers has been recognized for many years (Jacobs, 1977). Spradbrow and Power (2000) have documented that hard-of-hearing students in Australian universities also report that they miss information during lectures. Tutoring is one support service offered to accommodate this problem. Regardless of the country, this usually refers to a more individualized direct instructional approach, although group tutoring is also utilized. As mentioned earlier, Cremer (1991) found that in Germany, about six out of ten students in their study identified tutoring as essential to their success in higher education. As in England and other European countries, tutoring in Germany is a more direct instruction approach, rather than a support for reinforcing classroom learning. However, in the United States, tutoring has developed over time as an adjunct "support service" that provides deaf students with content learning and skills development *in addition to* their classroom experience. Orlando, Gramly, and Hoke (1997) found that deaf students in higher education seek tutoring in the United States not only to improve their course grades and study skills but to improve their understanding of lectures, to enhance their reading and writing skills, and to clarify their class notes. These latter reasons for seeking tutoring are direct reflections of deafness. Stinson (1987) also found that the students value the additional information they were able to acquire through tutoring and held positive attitudes toward this support service.

Lang, Biser, Mousley, Orlando, and Porter (2002) studied the perceptions of deaf students, university teachers, and faculty tutors regarding various dimensions. Perceptions of tutoring differed among these groups. The emphases in tutoring also reflected degree level. For baccalaureate students, the emphasis was primarily on course content, whereas for subbaccalaureate students, there was more focus in tutoring on the development of independent learning strategies, building confidence, organizing for class, and other general learning skills.

Lang et al. (2002) also found significant differences between the perceptions of mainstream university professors and deaf students regarding the expertise tutors

should have. Perhaps this difference between students and their professors may be explained partly by the fact that the professors have little or no training with regard to the special needs of deaf learners and has implications for how university professors might improve their understanding of the integral nature of and need for tutoring as an adjunct support service.

Other than these studies of perceptions, there has been little research on tutoring in the higher education of deaf students and the impact of tutoring on academic performance, despite the large number of such students receiving this support service. In particular, we know little about the most effective ways to tutor deaf students to enhance classroom success. Based on ratings about active learning, for example, Lang et al. (2002) recommend that research be conducted on whether tutors should model certain behaviors for students, or lead the students to discover principles or strategies.

Interpreting

There is a dire need to evaluate the relationship of interpreting to learning. In one study, Jacobs (1977) used a highly skilled interpreter and deaf students whose grade point average was comparable to that of hearing peers. Tests of immediate recall of short-term lecture content indicated that the deaf college students correctly answered about 84% as many items as the hearing students. There were significant differences favoring the hearing group in five of the six subtests. Quinsland and Long (1989) reported that deaf college students learning science through a skilled interpreter scored approximately twice as high as those learning through an unskilled interpreter. In this study with 60 deaf students learning the human corporeal circulatory system under six treatment conditions, students retained significantly more information when learning from an instructor who signed for himself as compared to those who learned through an unskilled interpreter. There was no significant difference between the direct instruction and skilled interpreter conditions.

As with tutoring, little research has investigated the relationship between interpreting and classroom learning. Several authors have suggested that the matching of communication between interpreter and deaf people (for example, American Sign Language [ASL] or

English-based signing) may be important (Seal, 1998; Winston, 1995). Content knowledge appears to be highly valued by deaf students in teachers (Lang, McKee, & Conner, 1993) and in tutors (Lang et al., 2002), but perceptions of the importance of the interpreters' familiarity with content material have also not been investigated. The accuracy and effectiveness of interpreting may depend on content knowledge. Familiarity with the content may lead to more appropriate sign selections and fewer misinterpretations of a professor's lecture emphases. In addition, an interpreter knowledgeable of the specialized vocabulary and proper names associated with a particular discipline may be more accurate and facile in terms of conveying the presenter's information (DeGroot, 1997; Seal, 1998; Winston, 1995). Napier (this issue) investigated the use of register and style by interpreters when interpreting for a university lecture in Australia. This study included an examination of the interpreters' educational background, their familiarity with academic discourse, and the influence of linguistic features and complexity of the lecture material on the interpretation. Issues such as the lexical and informational density of typical university lectures are discussed, as is the challenge posed by sign language, without a written orthography, with regard to translation. In this study, Auslan/English interpreters appeared to switch between translation styles at different points of the text. Napier concluded that the use of both free and literal methods as a linguistic strategy may be appropriate in a university context, where flexibility is needed in regard to sociolinguistic and sociocultural factors. With further research on these factors, comprehension by deaf learners may increase.

Interpreters who are aware of the barriers deaf post-secondary students experience, as identified in many studies cited here, for example, may be more able to adapt interpreting and advise teachers and students accordingly. As an illustration, college and university professors are often unaware of the reasons why deaf students do not participate in class discussions as much as their hearing peers. The question is thus whether an interpreter's own knowledge of these barriers, when shared with a professor in collaboration with the deaf student, may make a difference in the academic integration in the classroom. The resulting influence on content learning should also be investigated.

Not only is there an inadequate understanding of effective educational interpreting, there are also many misconceptions about access being made by those who work with educational interpreters in the classroom. As Winston (1995) summarizes, "the myths about interpreting need to be exposed before policies of inclusion through interpreting can be considered rationally" (p. 55).

Real-Time Captioning

Stinson, McKee, and Elliot (2000) describe several benefits of real-time captioning. First, for some real-time captioning systems, the display remains on the screen for enough time to allow students to check back and fill in information they might have missed from either the interpreter or teacher. Second, a hard copy of the complete lecture transcript may be available after class when the captions are stored in a computer's memory. Third, exact technical information and specific vocabulary are produced by the captionist. More research is needed in a number of areas. How does the reading ability of the deaf student relate to content learning through captions? Does the lag time inhibit participation by students in class discussions? Are there factors such as "body language" in face-to-face communication with teachers or interpreters that influence learning and are not offered in the purely textual approach of the real-time captioning display? As in interpreting, the question remains whether content knowledge of captionists may influence the quality of the information presented through text and thus, in turn, influence learning.

In addition, research is needed on the accuracy of information presented through captioning. In describing stenographic captioning systems in a Japanese post-secondary institution, for example, Kobayashi, Nishikawa, Ishihara, and Takahashi (1999) recommend studies on improving the ability to correct captioning errors, particularly when the rate of the lecture is high.

Note Taking

The literature on note taking and note review by hearing students assumes that students take their own notes. This is a difficult task for most deaf students in higher education. Language skills and the challenge of attending to multiple visual tasks (interpreters, teacher demon-

strations, etc.) make note taking inefficient. Osguthorpe, Long, and Ellsworth (1980) examined learning outcomes when deaf and hearing college students reviewed class notes and took tests of recall, recognition, concept acquisition, and problem solving. They reported that repeated review of class notes facilitated recall and recognition, but not concept acquisition or problem solving. They conclude that the findings "point to the limitations of review as a facilitative learning process" (p. 558). More research is needed on this issue.

Elliot, Stinson, McKee, Everhart, and Francis (2001) examined the perceptions of deaf students regarding the use of hard copy printouts from real-time captioning of classroom lectures. They report that the students in general found the notes to be very helpful, although some students did not integrate reading the notes into their regular study routines. Of the 36 students responding to a questionnaire, 29 said they skimmed the notes, 16 identified unfamiliar vocabulary and ideas, and 10 used the notes to create outlines. While the content of notes may vary when obtained from note takers, the real-time captioning printouts are closer to the original message, thus preserving the professor's meanings. However, the availability of such printouts may actually increase the workload for students, requiring time and energy to identify the critical points in a large transcript.

More research is also needed on the utilization of notes by deaf learners who "borrow" notes from peers. In addition, the extent to which students work with professors or tutors to learn through borrowed notes or transcripts generated by real-time captioning should be studied. How may notes stimulate additional interaction between students and professors? At present, little is known.

In summary, researching the effective use of support services to enhance learning is largely uncharted territory. When one type of support service is used, there are benefits both gained and lost. For example, when real-time captions are chosen over interpreting, we do not know how learning may be influenced by expecting students with recognized challenges in reading to focus primarily on the printed word. Similarly, if interpreting is chosen, we do not know the form and strength of the impact on learning by deaf students with various background characteristics, including communication pref-

erences. We also know little about the synergistic effect of using more than one support service. Finally, research needs to be conducted on the motivational factors that bring deaf students to use support services and the impact on learning that may result from failure to utilize those that are available.

Classroom Participation

Essential to the search for solutions is the issue of classroom participation of deaf students. There is a growing body of research indicating that the more students participate (e.g., active learning, interactive learning, classroom discussions, etc.), the more academically successful they will be. In a study focusing on learning styles of 100 deaf college students, Lang et al. (1998) employed the Grasha-Reichmann Student Learning Styles Scales, describing how each student's profile is made up of six scores representing different styles of learning. They found a moderate but significant correlation between the "participative" learning style and academic achievement as measured by course grades. As with similar studies with hearing students, it appears that the more involved a deaf student is in the classroom, the better that student's chance will be for learning the course material.

Research with a variety of instructional approaches has shown a possible pattern favoring "active learning" as compared to "passive learning." Several studies on instructional approaches that encourage participation and, especially, invocation of relevant active processing of information, have shown improvements in learning by deaf college students. Quinsland (1986) compared learning through a traditional lecture with an experiential learning (role playing) strategy followed by "processing" the information learned. He reported that the experiential treatment subjects demonstrated superior retention on a 3-day delayed test of factual knowledge. In addition, the effect was significant regardless of the locus of control or whether the deaf students were grouped as low-ability or high-ability readers.

On this subject of reading levels, Dowaliby and Lang (1999) compared learning science through passive reading of text, adjunct illustrations, and sign language translations with a more interactive approach where the students responded to questions while reading. On a

test of immediate factual recall, low-ability readers involved with the interactive learning strategy performed as well as high-ability readers who had the text without questions. The adjunct questions may have encouraged more thinking about what was being read than the more passive viewing of text, pictures, and signs. In both of these studies, the approaches that involved the students more resulted in better retention of knowledge.

Unfortunately, there is a larger body of research findings indicating that participation or active engagement by deaf students in higher education is one of the most difficult goals to meet in the mainstreamed classroom environment, which is characterized by instruction through support services. Saur, Layne, Hurley, and Opton (1986) describe in detail a number of barriers deaf students face in attempting to participate in mainstream classes, including pace (rate of presentation by instructor), the number of speakers involved, language and cultural difference, and the use of space (physical arrangements in the classroom). These factors have been repeatedly identified as problematic in other studies conducted over subsequent years.

Participation by deaf students in higher education classrooms may relate to the approach employed to communicate course content. Saur, Popp-Stone, and Hurley-Lawrence (1987) conducted a study in which they examined class participation of both deaf students and hearing students in a higher education environment when the instructor used simultaneous communication and when the same instructor used voice only, with a sign language interpreter translating. These investigators concluded that when instructors used simultaneous communication, deaf students, "on the average, tended to interact with the instructor as often as normal-hearing students. They did not do so when the instructor used only voice and an interpreter" (p. 281).

In a study of the perceptions of "academic engagement," Foster et al. (1999) reported that deaf and hearing postsecondary students generally viewed their communication ease and engagement as similar. There were many differences, however, in terms of the specific methods or needs for interacting within a class. Deaf students showed a significantly lower satisfaction than hearing peers with the teacher's pace, for example, expressing concern that teachers often do not make sure that understanding is occurring before proceeding with

the lecture. When asked to supply their own words to the sentence, "I feel like I am part of the classroom when I _____," 66% of the students expressed opinions along the line of "participate and learn by doing." But, according to these investigators, participation in discussions was inhibited for many deaf students because interpreters were not available, not familiar with the content, not visible from where the student was sitting, or not using a mode of signing similar to the student's. Forty-eight percent of the deaf students in this study mentioned interpreting as a factor. Whether these perceptions are supported by actual classroom observations remains to be determined. The perceptions of interpreters on this issue have also not been examined.

Effective Teaching—The Deaf Student's Perspective

What do we know about the efficacy of classroom teaching in higher education, with regard to delivery of the curriculum? Several studies have been conducted with deaf students and have employed different techniques and different operational definitions for the construct "effective teaching." Lang et al. (1993) used a structured response methodology, listing 32 characteristics and asking deaf students to rate and rank these behaviors in terms of their importance to learning course content. Lang, Dowaliby, and Anderson (1994) used an unstructured response method whereby 58 deaf postsecondary students were interviewed in depth and 839 "critical incidents" were collected. These incidents were actual classroom experiences that demonstrated, from the student's perspective, effective or ineffective teaching. "Effective teaching" was defined operationally in terms of student reports of motivation enhancement.

In general, deaf students had preferences similar to those of hearing students. They valued professors who are knowledgeable about the course content and who use visual materials, communicate expectations and assignments clearly, lecture at a good pace, make sure students understand, challenge students' thinking, and emphasize important information in the class (Lang et al., 1993).

Deaf students also appear to prefer teachers who are willing to adapt instruction to accommodate students with different needs (Lang et al., 1994). Foster et al.

(1999), however, reported that college and university faculty "generally indicated that they made few if any modifications for deaf students and saw support service faculty as responsible for the success or failure of these students" (p. 225). Whether this failure to adapt instruction is a result of attitude, a lack of training, or inadequate guidelines/resources remains to be determined through further research. The dilemma once again surfaces. What is needed or preferred by the deaf student does not appear to match what is offered.

Not surprisingly, there were two unique characteristics of effective teachers, specific to deaf students' judgments. First, they preferred professors who understood deaf people and deafness as an educational condition, a finding similarly reported by Spradbrow and Power (2000) in a study with hard-of-hearing students in Australian higher education. Second, students who use sign language valued teachers who were able to communicate clearly in signs.

Caccamise and Blasdel (1977) studied the receptive communication skills of 198 deaf postsecondary students under interpreted and simultaneous test conditions, reporting "the use of simultaneous communication to be preferred to interpreted communication for reception of information" (p. 414). The findings in these studies, and the one by Jacobs (1977) cited earlier, point to a need for more research in the relationship of direct communication between professor and student with respect to learning and to the impact of the interpreters' skills on the deaf students' academic success.

Spoken communication skills also appear to influence the participation of deaf students in higher education classroom activities. Stinson, Liu, Saur, and Long (1996) studied the perceptions of 50 deaf students regarding communication in classes. They reported that students more comfortable in using speech in the integrated setting in higher education have a "communication advantage." They appeared to be able to receive and send a greater amount of a higher quality of information than students who were less comfortable in using speech. These students usually had less severe hearing losses and higher California Achievement Test reading comprehension scores. The students varied considerably in their communication with hearing peers and with professors and in their concerns about access,

prompting these investigators to write that "it is a challenge for interpreting and other support services to serve these various needs, especially when it is not unusual for these variations to occur in the same classroom" (p. 41).

Stinson et al. (1996) also reported that the behaviors of hearing peers presenting the biggest obstacles included more than one student talking at the same time, rapid give-and-take, and discussing too many ideas at the same time. Success of deaf students in mainstream discourse situations is therefore highly dependent on their commitment to effective communication as well as the commitment of instructors and hearing peers. This commitment is not easily obtainable.

Conclusions

New research emphases are needed in the higher education of deaf students. Much information has been accumulated on the characteristics of deaf students entering higher education programs, including reading, writing, mathematics, and science assessment scores, background information on schools and families, and sign and spoken communication skills. A large body of additional research has been published on obstacles to access and success, particularly pertaining to student participation in class, study habits, social integration, and communication with peers and instructors. As a result, much is known about the characteristics of deaf students in higher education and the complex intertwining of social, linguistic, and cognitive factors that play roles in teaching and learning. The knowledge from this research that can be used practically, however, is limited. Recommendations for some research emphases follow.

Barriers Versus Solutions

The emphases on characteristics and obstacles have been predominant in the research conducted over the past 30 years; in fact, we know much less about potential solutions. What are the instructional, counseling, and support service innovations that might reduce the obstacles? Intervention strategies such as special courses or programs focusing on study skills or career awareness, based on the research findings about student

characteristics and obstacles, need to be systematically explored. Are there programmatic offerings on the secondary level or preparatory/prebaccalaureate courses or programs that improve academic achievement and retention of deaf students in degree programs?

Preparing Students for Higher Education

Brelje (1999) identified the lack of quality elementary and secondary educational opportunities as a major reason why many countries have few deaf students in higher education institutions. Regardless of the country, the academic and social/personal characteristics of deaf students that present obstacles to their success in postsecondary programs also have their roots in both inadequate early intervention (in infancy and childhood) and serious deficiencies in teacher preparation for elementary and secondary level schooling (Marschark, Lang, & Albertini, 2002). For reasons that certainly include limited resources, universities find themselves in a challenging catch-22 situation, unable to invest in research and development efforts to help parents and teachers to better prepare deaf children for the demands of postsecondary studies and unable to effectively address the needs of currently-enrolled deaf postsecondary students who are not well prepared for the rigor of many courses. The issues of early intervention and academic preparation in elementary and secondary programs have an undeniable direct bearing on the academic success of deaf students in higher education. For as long as colleges and universities are unable to effectively assist elementary and secondary school professionals and parents of young deaf children during the critical early school years, postsecondary programs will be doomed to post-hoc, band-aid programming.

As an example, this review of research revealed that deaf students withdraw from postsecondary programs because they have difficulty choosing a major that matches their interests and abilities (Scherer & Walter, 1988; Stinson & Walter, 1997). The need for improved career education has been repeatedly identified in surveys, needs assessments, and research studies over the past few decades (e.g., Prickett & Hunt, 1977; Schroedel, 1991) and indicates that renewed attention in elementary and secondary programs on the national

level might be beneficial. In the early 1980s, the National Project on Career Education (Bishop et al., 1980; Lang, 1982) addressed these concerns about career awareness education. When funding stopped, the innovations implemented in many school programs slowly disappeared over time. Thus, research is also needed on how to sustain "best practices" in light of ongoing turnover of both faculty and administrators in secondary school programs.

The Impact of Support Services on Learning

We need to expand the body of knowledge regarding the relationship support services have to actual classroom learning that might facilitate programmatic planning. It is especially important that researchers work toward finding solutions that lead to increased participation of deaf learners in the higher education classroom. Studies are needed that examine the relationship between academic achievement of, and participation by, deaf learners under conditions of direct instruction and when learning primarily through interpreted or real-time captioned lectures. Are there interpreting and real-time captioning strategies that promote more active participation in the learning process? Are there specific tutoring and note taking strategies or techniques that enhance academic success? Are these strategies specific to disciplines such as mathematics or writing courses? Are there synergistic effects introduced from combinations of support services, such as, for example, use of real-time captioning notes in tutoring sessions?

Nonacademic Factors

The critical nonacademic factors such as integration, self-efficacy, and identity should be examined, and a better understanding is needed of the role support services play in enhancing these social dimensions in the higher education setting. For example, would pairing hearing and deaf students in peer tutoring enhance integration? Would involving professors in closer collaboration with tutors be more effective than having largely independent professional or paraprofessional tutors work with deaf students? What strategies may educational interpreters incorporate to increase bonding between deaf

and hearing peers, or between deaf students and their professors? Would such increased bonding improve persistence of deaf postsecondary students to complete their degrees?

Professional Development for University Faculty

If participation is to be optimized in the higher education environment to increase the success of a wider population of deaf students, increased professional development efforts are needed for college and university professors, with particular emphasis on helping them to understand the critical nature of classroom participation and the psychosocial and communicative factors that may inhibit participation by deaf students. Enhanced collaboration between professors and the support service providers also needs to be examined (Lang et al., 2002).

Class Size

The issue of communication should especially be examined in terms of its intricate relationships to participation and class size. As mentioned earlier, classroom discussions present one of the most common opportunities for postsecondary students to participate. The larger the discussion group is in mainstream classrooms, the more difficult it is for deaf students to participate. Though no studies have directly addressed class size, it is logical to assume that smaller classes would facilitate participation by deaf students. Meta-analyses of class size conducted with hearing students support the view that learning generally improves as classes are made smaller. Glass and Smith (1978) analyzed over 80 empirical studies on class size and concluded that "reduced class size can be expected to produce increased academic achievement" (p. iv). Most of the studies reviewed involved younger hearing students. A probable explanation for the advantage of small classes is the fact that students are more actively engaged in learning than those in larger classes (Finn & Achilles, 1990).

Springer, Stanne, and Donovan (1999), also focusing on the education of hearing students, conducted a meta-analysis of 39 studies on the effects of small-group learning on undergraduates in science, mathematics,

engineering, and technology (SMET), concluding that various forms of small-group learning are effective in "promoting greater academic achievement, more favorable attitudes toward learning, and increased persistence through SMET courses and programs." The magnitude of the effects reported strongly supports more widespread implementation of small-group learning in undergraduate science, mathematics, engineering and technology.

Self-Advocacy

Several authors have also discussed the need to further investigate the development of self-advocacy skills in deaf and hard-of-hearing students in higher education. In analyzing the struggles for intellectual voice among marginalized learners, including women and minorities, Lang and Meath-Lang (1992) call for deaf learners in higher education to become more involved in redirecting their own destinies. They describe a working conference that involved students, professors, and other professionals who discussed barriers to learning. They write, "In their quest for increasing social and political consciousness, the participating students suggest that, as change agents, they be approached by teachers (and that they approach teachers) in dialogue about the barriers to learning as well as the course content" (pp. 83-84). Similarly, in a study with postsecondary hard-of-hearing students in Australia, Spradbrow and Power (2000) found that a majority of the students were missing out on access to some of the content of the lectures and tutorials. They write that "we should not just consider what the people in support program can do to change the way lecturers and other students interact with the hard of hearing students. . . . We should also consider how we can assist the hard of hearing student to gain the necessary skills and confidence to . . . be able to explain their difficulties in a non-threatening way to others . . . [and] to give information to others [about accommodations]" (pp. 10-11).

The Role of Technology

In 1997-1998, almost 44% of all higher education institutions in the United States offered distance learning

courses. A breakdown of these data indicated that 78% of 4-year programs and 62 percent of 2-year institutions offered some form of distance learning (Lewis, Farris, Snow, Levin, & Greene, 1999). The Education Department provided \$30 million of funds for "Learning Anytime Anywhere Partnerships" (Carnevale, 2001). With such a growing emphasis on learning electronically from off-campus, research is needed to examine whether such web-based educational programming is fully accessible to deaf learners and whether such a format for instruction places greater demands on reading skills.

Sharing Research Internationally

Professionals involved in higher education as well as elementary and secondary education of deaf students must reconceptualize the strategies used to disseminate research findings. Typically, educational research is published in journals read mostly by other researchers, and to a much lesser degree by administrators, teachers, parents, and other gatekeepers who make daily decisions that affect the deaf child's progress and preparation for postsecondary-level work. The research is also often not communicated in a manner that can be applied readily to practice.

Systemic reform depends in great part on the quality of the information disseminated in a network. Such efforts in the field of educating deaf students include national general networks such as the Postsecondary Education Programs Network (PEPNet) and those focusing on specific disciplines, such as the National Science Foundation-funded Clearinghouse On Mathematics, Engineering, Technology, and Science (COMETS). PEPNet is a national collaboration of the four Regional Postsecondary Education Centers for Individuals who are Deaf and Hard of Hearing, which are supported by contracts with the U.S. Department of Education, Office of Special Education and Rehabilitation Services. Its goal is to assist postsecondary institutions across the nation to attract and effectively educate deaf students. COMETS includes the development of a prototype for pooling research findings and promoting dialogue among a variety of target audiences. At postsecondary level, this will involve educating university professors about the barriers deaf students face in their classrooms,

information for support service professionals to optimize access, and information for deaf postsecondary students that will facilitate their learning (Lang & Kovalik, 2001).

The aggregate results of a wide array of investigations, communicated and evaluated through dialogue among researchers and other professionals, will allow recommendations to be made about how teaching and learning, teacher development, and research affect each other. Research findings reported across different contexts may suggest directions for policy makers, while also raising important issues for further study. Through such research and networking initiatives in the new millennium, a fuller range of educational innovation efforts may help policy makers reach informed decisions about ongoing systemic reform. By taking an integral role in addressing the issues that are central to reform, researchers will help educators become more active consumers of research findings and more active in formulating the research agenda.

Educational research is a useful tool for effecting positive change through innovation. Discovering new ways to synthesize meaningful research findings and translating them to improved access and success for deaf students in higher education should be a priority.

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